Using Coral Reefs as Indicators of Land-Based Pollution

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Summary of Presentation

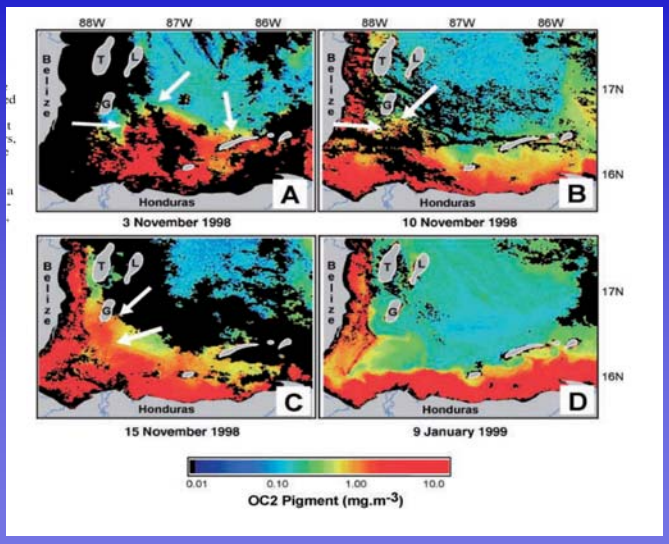
- Present brief synopsis of published studies that have successfully documented how land based pollution sources alter reef communities

- Describe CNMI's marine monitoring efforts including selection of methodologies, analysis of results

Sources of Land Based Pollution

- Poor agriculture practices
- Upland sediment particles from burning or clearing
- Urban runoff
- Failing sewer infrastructure
- Nutrient rich groundwater discharge

Using Remote Sensing



Andrefouet et al., Coral Reefs, V. 21, 2002 (http://seawifs.gsfc.nasa.gov/SEAWIFS.html)

Effects on Benthos

- Rogers, C. S. 1990. **Responses of coral reefs and reef organisms to sedimentation**. Marine Ecology Progress Series 62: 185-202.
- Loya, Y., 1976. **Effects of water turbidity and sedimentation on the community structure of Puerto Rican corals**. Bulletin of Marine Science 26(4): 450-466.
- Randall, R. H., and C. Birkeland. 1978. **Guam's reefs and beaches part II sedimentation studies at Fouha Bay and Ylig Bay**. University of Guam Technical Report No. 47.

- Scientist have and will continue to provide information on how these pollution sources affect reefs
- How can we quantify the extent of negative effects and discover links to sources, e.g. the BIG picture

Quantifying the Extent of River Discharge

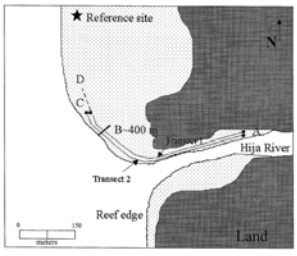
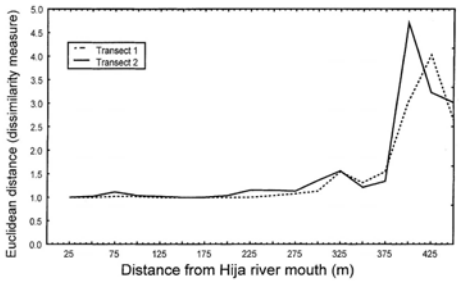
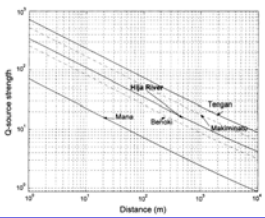


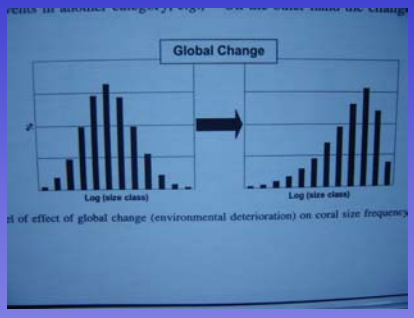
Fig. 2 Schematic diagram of the Hija River study area. Transects were placed approximately 5 m apart at 2 m depth (below mean low water datum).





West and Van Woesik, Marine Pollution Bulletin, V. 42, No. 10, 2000

Understanding Urban Runoff (using coral demography)



Bak & Meesters 1999. Am Zool 39: 56-65

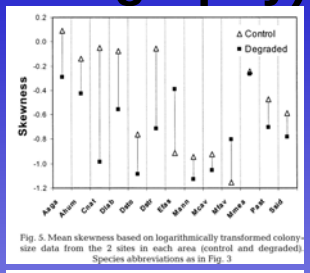


Fig. 5. Mean skewness based on logarithmically transformed colony-size data from the 2 sites in each area (control and degraded). Species abbreviations as in Fig. 3

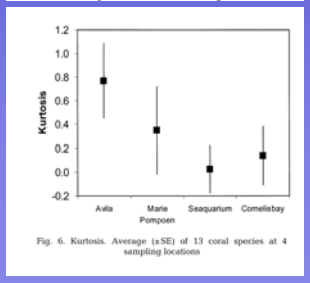


Fig. 6. Kurtosis. Average (±SE) of 13 coral species at 4 sampling locations

Meesters et al., Marine Ecology Progress Series, V. 209, 2001

CNMI Marine Monitoring Program

- Selection of sites
  - Based on Hypotheses
- Choosing methodologies
  - Benthic
  - Coral Community
  - Invertebrate Abundance
  - Biodiversity
  - Water Quality
- Analysis of Results
  - Data must provide statistically proven results

www.deq.gov.mp/MMT/Marinehome.htm

Selection of Sites

- Sites with hypothesized disturbance
- Control Sites
- Sites in differing habitats (communities)

www.deq.gov.mp/MMT/Marinehome.htm

Methods

- **Video benthic analysis**
  - Transect length
  - Number of replicates
  - Number of frames
  - Number of dat

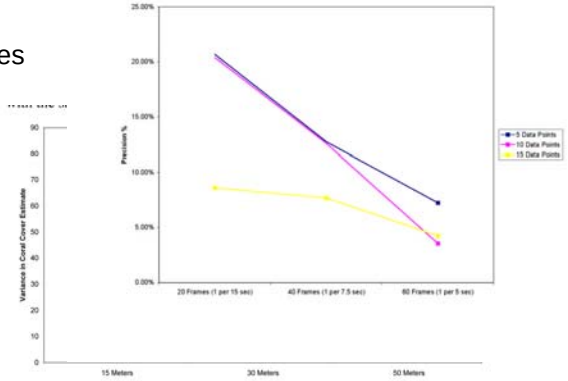


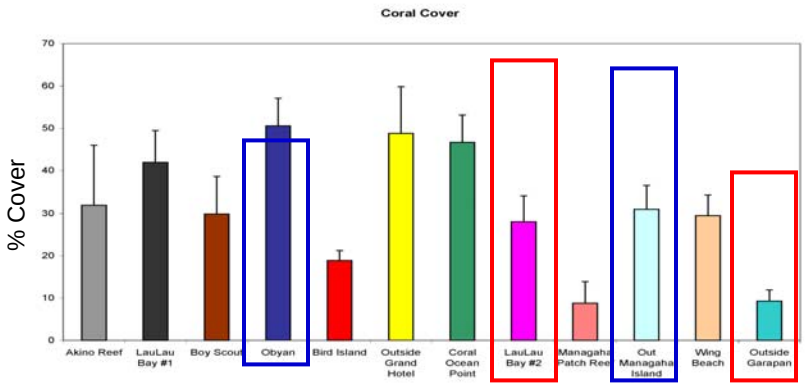
Figure 3. Variance in coral cover estimates at various transect lengths, analyzing 5, 10, and 15 data points per frame.

Unpublished study

Methods (cont..)

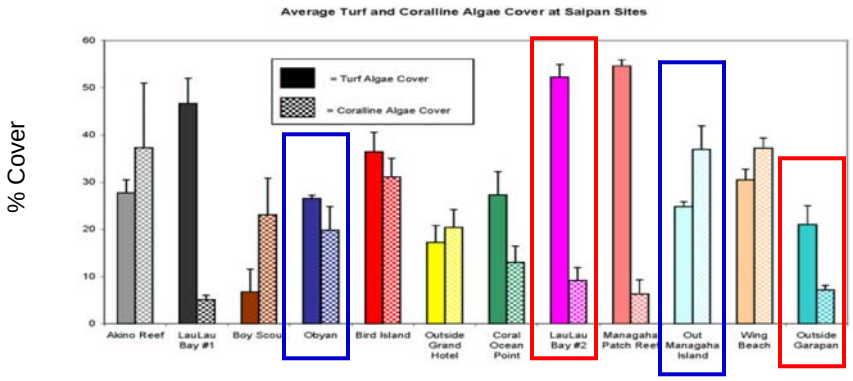
- **Coral Communities**
  - Demography
  - Relative Abundances
    - Point Quarter
    - Standard Quadrats
  - Recruitment
    - Belt transects
- **Biodiversity**
  - Checklist
  - Specimen collections
- **Invert Abundances**
  - Belt transects
- **Water Quality Data**

Results (benthic coverage)



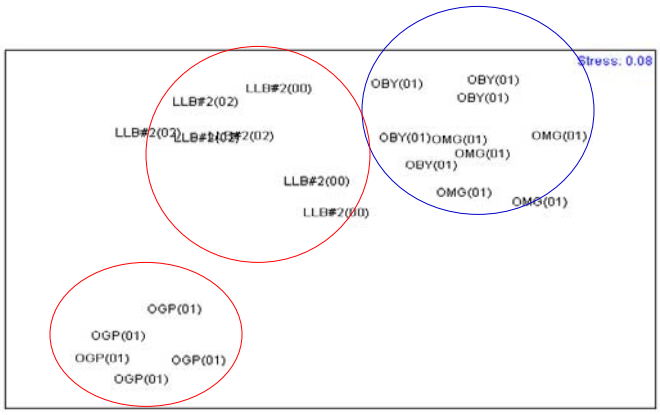
www.deq.gov.mp/MMT/Marinehome.htm

Results (benthic coverage)



www.deq.gov.mp/MMT/Marinehome.htm

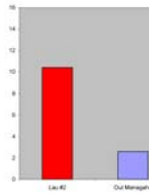
Results (benthic coverage) multivariate analysis



Disturbed Sites

Non-Disturbed Sites

Results (coral community)



Lau Lau Bay #2 Site

Coral Name	N	Relative Abundance
Porites rus	26	35.78
Astreopora myriophthalma	10	15.9
Porites lichen	5	7.85
Goniastrea retiformis	16	7.25
Astreopora randalli	13	6.52
Galaxea fascicularis	6	4.59

Outside Garapan Site

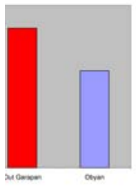
Coral Name	N	Relative Abundance
Astreopora randalli	7	28.05
Psammacora nierstraszi	1	24.62
Porites lobata	6	16.79
Leptastrea purpurea	13	5.26
Cyphastrea chalcidicum	5	4.97
Favites russelli	13	2.85

Obyan Site

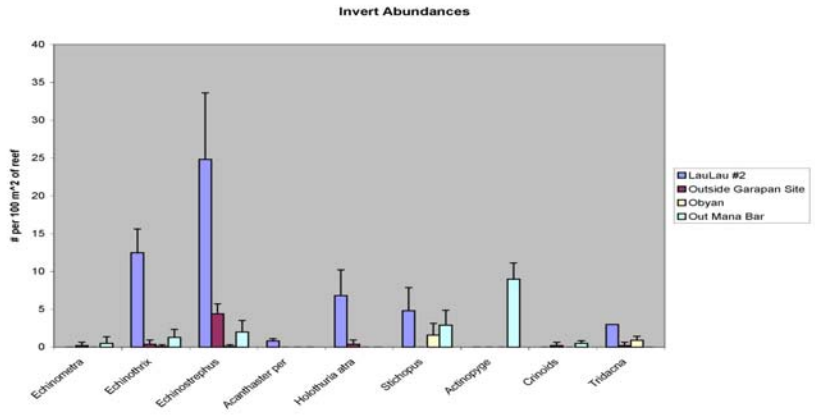
Coral Name	N	Relative Abundance
Montipora c.f. grisea (CNMI Coll)	6	25.07
Porites rus	15	10.61
Stylophora mordax	8	9.68
Goniastrea retiformis	9	7.94
Montipora c.f. monasteriata (CNMI Coll)	5	6.45
Pavona duerdeni	1	4.73

Outside Managaha Site

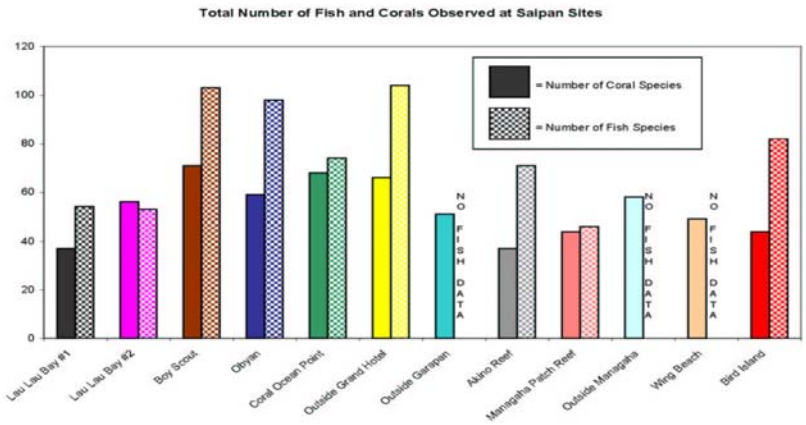
Coral Name	N	Relative Abundance
Acropora humulis	6	7.46
Montipora c.f. efflorescens (CNMI Coll)	12	6.2
Stylophora mordax	12	4.75
Acropora surculosa	5	4.49
Montipora c.f. grisea (CNMI Coll)	5	3.16
Porites vaughnii	27	2.38



Results (invert abundances)



Results (Biodiversity)



Conclusions

- Many types of data collection facilitate interpretation of the effects of land based pollution on coral reefs.
- Success or failure may be region specific.
- We have set-up a monitoring program to address specific questions - not collected data and see what works.
- Use existing published studies to assist in data collection and interpretation.